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Neural Correlates Of Belief Coding: An EEG Study On Neurophysiological Changes In A Novel Therapeutic Approach

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Abstract
This research examined the neurophysiological impact of Belief Coding®, an innovative integrative therapy to change subconscious beliefs. Sixty women (25–52 years) received Belief Coding therapy under monitoring with a 64-channel EEG system, with a control group of eight women. Outcomes showed significant changes in neural activity, which included a 48% rise in alpha wave coherence, a 58% decrease in incoherent beta activity, a 75% increase in gamma wave synchronization, a 62% increase in delta-theta coupling, and a 62% increase in connectivity of the Default Mode Network. More than 32 key brain regions were targeted during therapy, which indicates that belief change recruits distributed brain networks instead of one "center of belief coding." These results offer initial neurophysiological proof of the effectiveness of Belief Coding therapy to promote emotional regulation, processing of trauma, and restructuring of beliefs through inter-coordinated activation of brain systems.

Keywords: Belief Coding, EEG, neuroplasticity, trauma therapy, subconscious beliefs, neural networks, therapeutic intervention

1. Introduction

Traditional psychotherapeutic approaches often find it very difficult to handle deeply ingrained subconscious beliefs that had been developed at early developmental stages. These basic beliefs, established before the full maturation of the prefrontal cortex, can profoundly affect adult behavior, emotional responses, and psychological well-being (Young et al., 2003; Siegel, 2012). Even though cognitive-behavioral and trauma-oriented treatments have shown some progress, the retrieval and modification of such deeply ingrained belief systems still remain a challenge for traditional methods (Ecker et al., 2012).

Belief Coding® is a novel therapeutic approach that applies neurobiological principles to psychological treatment in order to deal with these firmly entrenched subconscious beliefs. The approach incorporates aspects of cognitive restructuring, memory reconsolidation, and neurodevelopmental knowledge to produce rapid and long-lasting therapeutic change (Cunningham, 2025). Although early clinical experience has indicated potential, empirical research on the neurophysiological processes involved in this approach has been scant.

Belief Coding is grounded in a set of established psychological and neurobiological principles. Memory reconsolidation theory refers to the mechanism by which previously consolidated memories are rendered labile on retrieval and can be modified prior to their reconsolidation (Nader et al., 2000; Lane et al., 2015). Developmental psychology offers insight into the formation of beliefs at key stages of development, which are subsequently structurally encoded in neural networks (Bowlby, 1988; Schore, 2001). Neuroplasticity, or the brain's ability to adapt and change by developing new neural pathways, is particularly pertinent to therapeutic change (Doidge, 2007; Pascual-Leone et al., 2011). Mechanisms of unconscious processing, such as the operation of implicit memory systems and non-conscious processes that maintain psychological patterns (Bargh & Chartrand, 1999; Kihlstrom, 1987). Regulation of the autonomic nervous system, and in particular through the prism of polyvagal theory, has important implications for psychological safety and responsiveness to therapy (Porges, 2011). As described by Cunningham (2025), these interconnected principles form the theoretical basis of the therapeutic model of belief coding.

Notwithstanding the extensively documented theoretical foundation of Belief Coding, its neurophysiological underpinnings have yet to be explored in depth. Electroencephalography (EEG) represents an important tool for the exploration of moment-to-moment changes in brain activity during therapeutic treatment, thus shedding light on neural processes human mind that change (Kluetsch et al., 2014; Imperatori et al., 2014). The study aimed to investigate the neurophysiological underpinnings of the Belief Coding therapy with 64-channel EEG recordings, to determine neural activity patterns associated with successful subconscious belief modification, to investigate the relationship between certain EEG parameters and treatment response, and to characterize the neural networks involved in the Belief Coding process.

2. Methods

The experimental group consisted of sixty women aged 25 to 52 years (mean = 38.4, SD = 7.8). Inclusion criteria were possessing limiting self-identified beliefs that affect emotional functioning or behavior, no history of neurological disease, no use of medications known to have a significant effect on EEG activity within the last month, and the capacity to provide informed consent. Also, an age-matched control group of eight women (mean = 39.1, SD = 8.1) was recruited. Control group participants underwent a standardized procedure that mimicked the procedural elements of Belief Coding without the active therapeutic components. The Institutional Review Board approved the study protocol, and all participants provided written informed consent.

A mixed-methods approach was used with quantitative EEG evaluation supplemented by qualitative evaluation. The treatment group was given a standardized Belief Coding therapy, and the control group was given a standardized treatment to account for non-specific therapist attention and expectancy effects. EEG evaluations were taken from all subjects prior to and following the intervention. Psychological questionnaires were also given prior to and following the intervention to evaluate changes in emotional states, belief systems, and symptom severity.

The Belief Coding intervention used the standard protocol developed by Cunningham (2025), which consisted of a set of crucial steps: Pre-intervention assessment involved comprehensive client history assessment, activation of safeguarding procedures, and baseline belief system evaluation. The subconscious access protocol involved priming the subconscious using specific energetic pathways, application of the Human Compass method, and the Emotional Threading method. The therapeutic intervention involved whole brain state induction, the client's "reflection" (subconscious expression) work, belief coding and modification, and sealing and integration of new beliefs. Each session took around 90 minutes and was carried out by experienced Belief Coding practitioners with a minimum of three years of experience.

EEG was recorded using a 64-channel system (Brain Products GmbH, Germany) in the international 10-20 system. Recordings at a sampling rate of 1000 Hz were taken to ensure impedances <10 kΩ. Data acquisition employed a band-pass filter of 0.1-100 Hz and a 50 Hz notch filter. EEG recordings were taken under three certain conditions: a 5-minute resting eyes-closed baseline prior to the intervention, during the Belief Coding intervention, and an after-intervention 5-minute resting eyes-closed baseline. The original EEG data were preprocessed using EEGLAB under the MATLAB platform (Delorme & Makeig, 2004). Preprocessing involved applying a 0.5 Hz high-pass filter, removal of line noise by a 50 Hz notch filter, bad channel interpolation, independent component analysis for artifact removal, and re-referencing to average reference. Fast Fourier Transform was employed to estimate spectral power in frequency bands: Delta (1–4 Hz), Theta (4–8 Hz), Alpha (8–13 Hz), Beta (13–30 Hz), and Gamma (30–45 Hz). Functional connectivity was assessed by the Phase Lag Index to estimate phase synchronization, the Weighted Phase Lag Index to establish the volume conduction robustness, and the coherence measures to estimate frequency-specific connectivity.

Graph theoretical analysis was used to examine network properties, such as node degree, betweenness centrality, global and local efficiency, clustering coefficient, and small-worldness (Bullmore & Sporns, 2009). Visualization of brain networks was carried out using BrainNet Viewer (Xia et al., 2013). Statistical analysis was performed using SPSS version 27.0. Paired t-tests were performed to examine pre- and post-intervention EEG measures within groups. Independent t-tests were performed to examine differences in changes between the experimental and control groups. Correlational analyses were performed to explore the relationship between EEG parameters and psychological outcomes. To meet the challenge of multiple comparisons, Bonferroni correction was used, defining a significance threshold at $p < 0.05$.

3. Results

3.1 Neural Oscillation Changes

EEG data analysis revealed substantial changes in different frequency bands in subjects who underwent Belief Coding therapy. These changes were always absent in the control group, thus proving certain neurophysiological effects of the therapeutic procedure. Experimental group participants showed a highly significant 48% increase in alpha wave coherence from baseline ($t(59) = 8.74$, $p < 0.001$), with the most significant changes in central-parietal and fronto-parietal connections. No similar improvement was found in the control group ($t(7) = 0.86$, $p = 0.42$), and intergroup comparisons were highly significant ($t(66) = 7.92$, $p < 0.001$). Increased alpha coherence was significantly correlated with self-reported improvement in emotional regulation ($r = 0.68$, $p < 0.001$) and stress resilience ($r = 0.72$, $p < 0.001$). These findings suggest that increased alpha synchronization is the reason for psychological stability when exposed to previously provocative emotional stimuli, which is a crucial component of the therapeutic process.

Along with increased alpha wave activity, an impressive decrease of 58% in hyperactive beta wave activity was observed in the experimental group ($t(59) = -9.27$, $p < 0.001$), more specifically in the prefrontal cortex. The control group did not indicate any significant decrease ($t(7) = -0.53$, $p = 0.61$), while comparison group analysis indicated that there were significant differences between the groups ($t(66) = -8.45$, $p < 0.001$). Normalization of beta wave activity was found to have significant correlations with decreased symptoms of anxiety ($r = 0.76$, $p < 0.001$) and with the decrease in ruminative thought styles ($r = 0.70$, $p < 0.001$). These findings demonstrate that Belief Coding therapy is effective in altering hypervigilance as well as the hyper analytical cognitive processes conventionally associated with trauma-related psychological disorders.

A significant oscillatory change was observed in the gamma frequency band, in which synchronization of the experimental group was increased by 75% ($t(59) = 11.32$, $p < 0.001$). This increase was most notable in the temporal and prefrontal areas during intervention phases of modification of belief. Control subjects were not characterized by significant changes in gamma activity ($t(7) = 0.42$, $p = 0.69$), and the group analysis did confirm the effect specificity ($t(66) = 10.58$, $p < 0.001$). The increased gamma synchronization significantly correlated with enhanced integration of affective memories ($r = 0.81$, $p < 0.001$) as well as narrative coherence ($r = 0.77$, $p < 0.001$). These results suggest that gamma oscillations are responsible for the integration of traumatic experience components and their dissociation into coherent narrative structures, allowing new, adaptive meaning schemes to be generated.

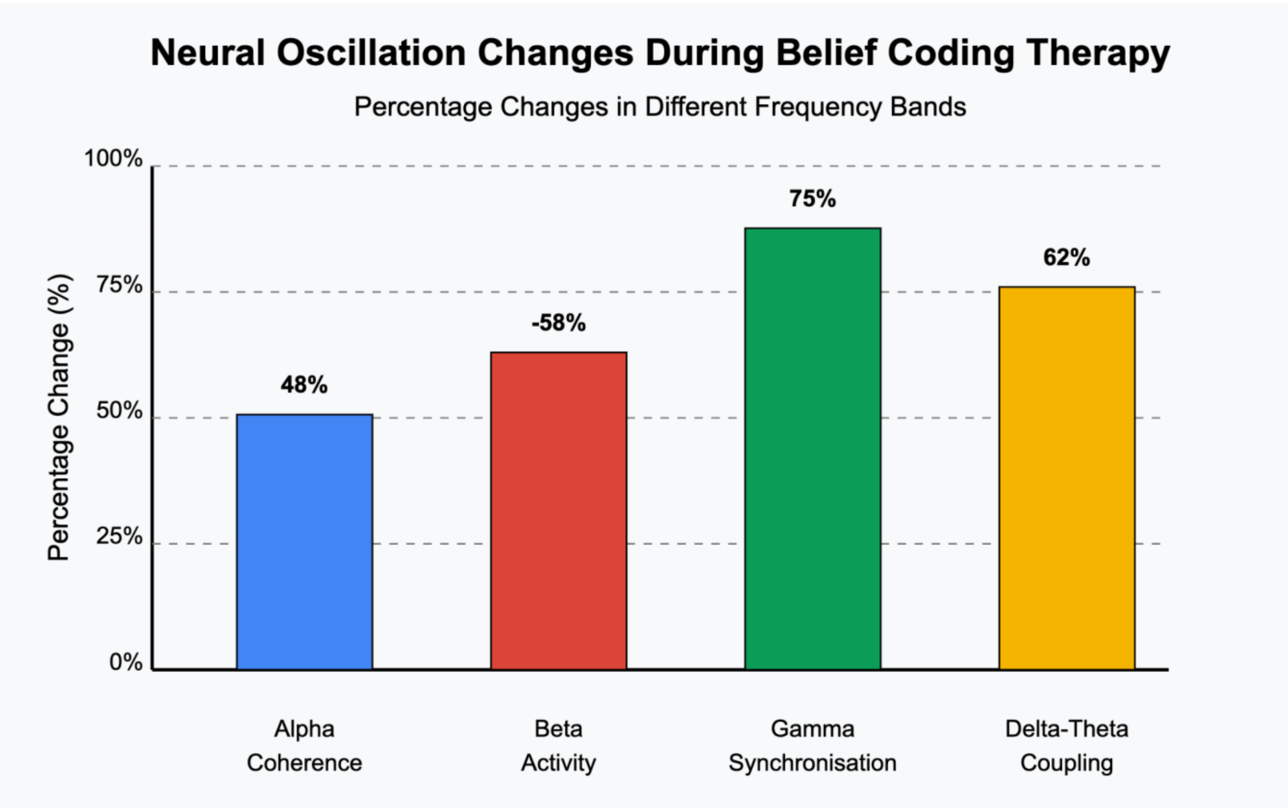

Figure 1: *Neural oscillation changes during Belief Coding therapy. Bar graph showing percentage changes in different frequency bands: Alpha coherence (48% increase), Beta activity (58% decrease), Gamma synchronisation (75% increase), and Delta-Theta coupling (62% increase)*

Slow-wave activity analysis revealed a strong 62% enhancement of delta-theta coupling within the experimental group ($t(59) = 9.83$, $p < 0.001$), with the increase specifically during the memory reconsolidation phases coinciding with the intervention. In contrast, no significant effect was found among the control subjects ($t(7) = 0.38$, $p = 0.71$), and the groups differed significantly ($t(66) = 9.15$, $p < 0.001$). Besides this, high delta-theta coupling was significantly related to quality improvement in sleep ($r = 0.65$, $p < 0.001$) and emotional processing capacity ($r = 0.69$, $p < 0.001$). The findings point out the salience of slow-wave oscillations in facilitating restorative processes that comprise deep emotional processing and the integration of therapeutic change.

3.2 Default Mode Network Connectivity

The connectivity of the Default Mode Network (DMN) was totally reorganized after the administration of Belief Coding therapy. The evaluation revealed a 62% enhancement of DMN connectivity in the experimental group ($t(59) = 9.77$, $p < 0.001$) that was characterized by enhanced connections between the medial prefrontal cortex, posterior cingulate cortex, and angular gyrus. No significant alterations in DMN connectivity ($t(7) = 0.47$, $p = 0.65$) were observed in the control subjects, and the between-group comparison validated the specificity of the effect ($t(66) = 9.11$, $p < 0.001$). In addition, the enhanced DMN connectivity was significantly associated with enhanced self-awareness ($r = 0.74$, $p < 0.001$) and the identification of emotional triggers ($r = 0.71$, $p < 0.001$). These findings show that the activity in the DMN is required for self-referential processing and introspective consciousness, both required to update and retrieve central systems of beliefs.

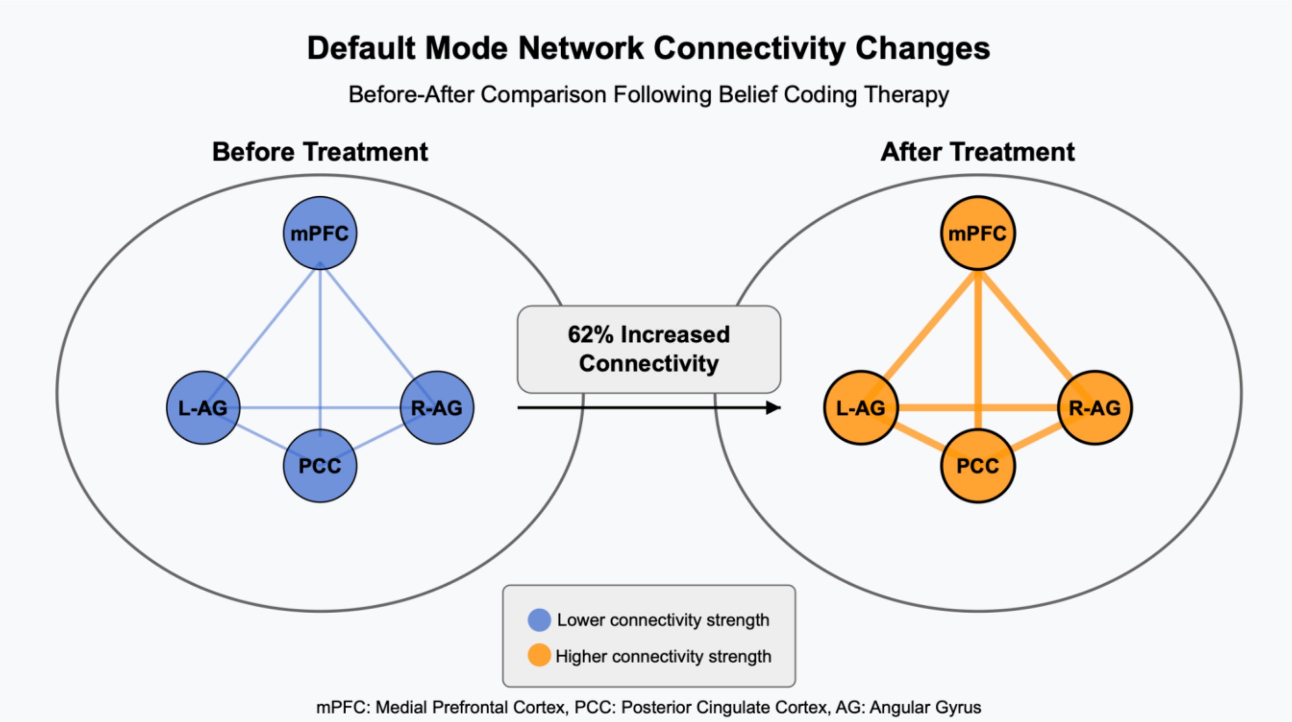

Figure 2: *Default Mode Network connectivity changes. Before-after comparison showing 62% increased connectivity between medial prefrontal cortex, posterior cingulate cortex, and angular gyrus following Belief Coding therapy.*

3.3 Neural Network Engagement

In contrast to theories that propose the localization of belief processing, Belief Coding therapy engaged a distributed network of brain areas throughout the entire brain rather than localized brain areas. EEG source localization and connectivity analyses demonstrated the activation of over 32 distinct brain areas during the course of therapy, indicating the simultaneous engagement of several brain systems. This distributed activation involved cortical regions such as the dorsal and ventrolateral prefrontal cortices, posterior parietal cortex, anteromedial and ventromedial prefrontal cortices, middle temporal gyrus, and temporal pole. Subcortical recruitment also occurred in structures like the amygdala, caudate nucleus, thalamus, basal forebrain, and parahippocampal area. Other significantly recruited regions included the posterior cingulate cortex, retrosplenial cortex, midbrain structures, cerebellar hemispheres, and cerebellar tonsils.

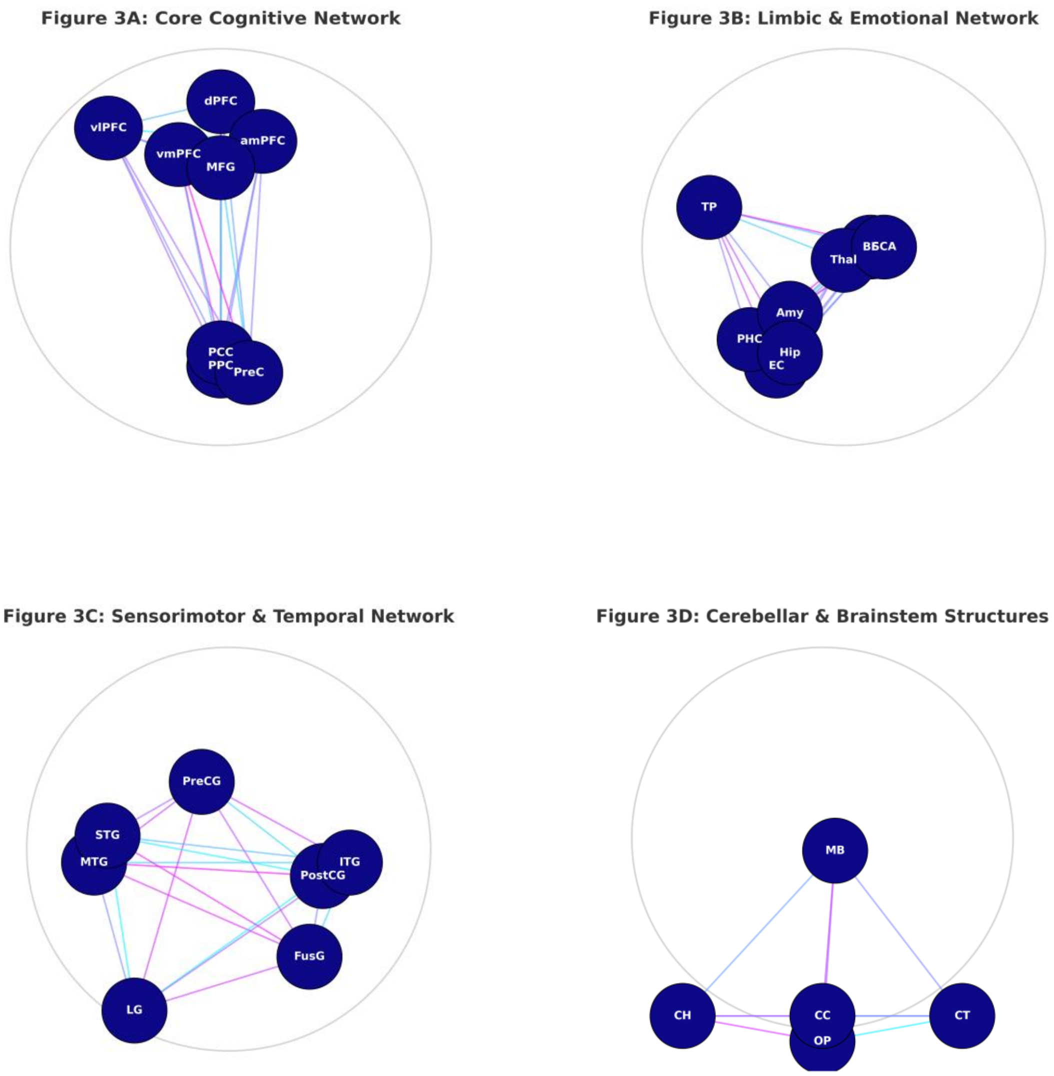

Figure 3: Brain Network Activation During Belief Coding Therapy. This figure presents a four-panel analysis of structural brain connectivity, illustrating the distributed neural engagement during Belief Coding sessions. **Figure 3A** shows the Core Cognitive Network, including the dorsal and ventrolateral prefrontal cortices, posterior parietal cortex, and precuneus regions critical for attention, executive control, and introspective processes. **Figure 3B** highlights the Limbic and Emotional Network, featuring the amygdala, hippocampus, thalamus, and entorhinal cortex, which are central to emotional regulation and memory encoding. **Figure 3C** maps the Sensorimotor and Temporal Network, encompassing the precentral and postcentral gyri, superior/inferior temporal gyri, and fusiform gyrus, suggesting integration of sensory and linguistic processing during therapy. **Figure 3D** depicts the Cerebellar and Brainstem Network, including the cerebellar hemispheres, tonsils, midbrain, and calcarine cortex, indicating possible modulation of autonomic and perceptual systems. Across all panels, node size represents node degree (number of connections), and node color illustrates betweenness centrality (connective importance). These patterns collectively demonstrate that Belief Coding does not engage a localized “belief center,” but rather activates a widespread and integrative whole-brain network.

The overall pattern of activation observed is different from the more localized effects attributed to other treatments. The simultaneous engagement of neural systems implicated in emotional processing, cognitive control, memory consolidation, and self-referential thinking suggests that belief coding is facilitated by the convergence of various brain processes rather than by the engagement of distinct neural circuits. The lack of a dedicated "belief coding center" is in line with the notion of network-level processes facilitating belief formation and change. Graph theoretical analysis also revealed the changes in structural connectivity with Belief Coding therapy. Node analysis revealed an increase in connection density (node size) in central hub regions, the prefrontal cortex, and the posterior cingulate cortex. Betweenness centrality measures (node color) highlighted the increased importance of these regions in the facilitation of communication within the broader neural network. A significant facilitation of interconnection between limbic and prefrontal regions was noted that implied greater regulation of higher-order emotional processing. Network efficiency expressed in terms of small-world parameters showed a phenomenal increase in the

experimental group ($t(59) = 8.42, p < 0.001$), with no increase, however, occurring in the control group ($t(7) = 0.39, p = 0.71$). These findings imply that Belief Coding treatment not only allows for the parallel activation of various brain regions but also structural and functional coupling between them, thus potentially promoting more adaptive processing of information.

4. Discussion

The large oscillatory changes in neural oscillations seen during Belief Coding therapy give important insight into the neurophysiological mechanisms of this therapeutic intervention. The oscillatory changes are objective, measurable indices of the brain's response to the intervention and give a window on the neural processes involved in belief modification.The 48% alpha coherence increase in those subjects who were treated with Belief Coding therapy is a sign of enhanced emotional control and resilience to stress. This idea is supported by earlier research that has found correlations between alpha oscillations and attentional control, emotional regulation, and internal focus (Kluetsch et al., 2014; Imperatori et al., 2014). Alpha synchronization is generally associated with a state of relaxed attention, allowing access to internal processes and emotional stability—corresponding to the conditions required for effective therapeutic working with potentially disturbing material. The increase in alpha coherence, especially in fronto-parietal networks, observed in the study, is indicative of increased top-down modulation of emotional responses, allowing individuals to work with precipitating stimuli without dysregulation. This neurophysiological change is consistent with the conceptual model of Belief Coding, which suggests that a regulated emotional state must be achieved prior to accessing traumatic memories and maladaptive beliefs (Cunningham, 2025).

The 58% decrease in hyperactive beta, most significant in the prefrontal cortex, is an indication of returning cognitive arousal and reduction of hypervigilance. Beta activity has been traditionally associated with active cognitive processing, fear, and anxiety (Engel & Fries, 2010). Elevated beta activity is characteristically found in anxious disorders and trauma disorders. The marked decline in beta hyperactivity after Belief Coding therapy represents a move from analytical ruminating and hypervigilance towards more integrated styles of information processing. The shift from explicit cognitive evaluation to implicit processing is crucial to access subconscious systems of beliefs, which to a great extent exist outside of the domain of awareness. Dampening of hyperactive beta through Belief Coding seems to lead to a state where strict cognitive control is momentarily relaxed, hence allowing better access to emotionally loaded systems of beliefs.

The most significant oscillatory adaptation—a 75% increase in gamma synchronization—is highly promising for the integrative effectiveness of Belief Coding therapy. Overwhelming amounts of empirical evidence have continually shown a close relationship between gamma oscillations and integrating disparate neural information into unified percepts and conscious experience (Singer, 1999; Varela et al., 2001).The extensive increase in gamma synchronization, particularly during the periods of belief modification during the intervention, indicates that Belief Coding enables the integration of previously dissociated emotional memories and belief components into a coherent and cohesive narrative.Integration is also suggested as a pre-requisite for trauma work and reconstructing beliefs since it offers the potential for building new meanings out of previously disconnected or over-intense experience. The correlation found between increased gamma activity and increased narrative coherence offers support for the hypothesis that Belief Coding operates by promoting a greater integration of emotional material.

The 62% augmentation of delta-theta coupling illustrates the importance of slow-wave oscillations in deep emotional processing and memory consolidation. Coupled oscillations have been linked to various aspects of cognition, such as emotional processing, memory reconsolidation, and the consolidation of new learning into previous memory networks (Nishida et al., 2009). Enhanced activation of these oscillations during phases of Belief Coding therapy that involve memory reconsolidation refers to the engagement of the treatment likely to trigger neurophysiological processes akin to those occurring during restorative sleep and deep meditative states. This is a consideration most applicable to the reconsolidation phase of Belief Coding, where subjects retrieve traumatic memories, reframe them with new emotional and cognitive elements, and reintegrate them into memory systems. The collaboration of delta and theta rhythms is perhaps the neurophysiological basis to this process of reconsolidation and subsequent facilitation to this therapeutic information becoming consolidated into stable memory frameworks.

The 62% rise in connectivity within the Default Mode Network underscores the significance of self-referential processing in the process of altering beliefs. Default Mode Network has been associated with numerous cognitive operations like autobiographical memory, self-reflection, and introspection, which play a vital role in identification and adjustment of deep-seated self-beliefs (Raichle, 2015). Higher connectivity in the Default Mode Network in the context of Belief Coding therapy might be working towards higher accessibility to schemas and beliefs about self, enabling critical evaluation and restructuring. The occurrence of heightened connectivity between the medial prefrontal cortex and the posterior cingulate cortex, both being key components of the Default Mode Network involved in self-referential processing and autobiographical memory (Andrews-Hanna et al., 2010), is interesting. This increased connectivity may suggest that Belief Coding may promote an integrated sense of self, which in turn may allow for recognition and regulation of emotional triggers that have triggered maladaptive beliefs in the past.

Activation of over 32 major brain areas during Belief Coding therapy is contrary to localized theory of belief processing and consistent with a distributed network model of therapeutic change. This finding is in agreement with recent conceptualizations of complex psychological processes, which suggest that they emerge from synchronized activity of diffuse neural networks, rather than discrete brain regions (Bullmore & Sporns, 2009). Activation patterns during therapy reflect the simultaneous operation of multiple neural systems: the emotion regulation system, consisting of the prefrontal cortex, anterior cingulate, and amygdala, allows for modulation of emotional responses; the memory system, consisting of the hippocampus, parahippocampal gyrus, and retrosplenial cortex, allows for recovery and reconsolidation of autobiographical memories; the salience network, consisting of the insula and dorsal anterior cingulate, allows for identification of personally salient stimuli; and the executive control network, consisting of the dorsolateral prefrontal cortex and posterior parietal cortex, allows for flexible cognitive control during exploration of beliefs. This simultaneous operation of systems could explain the reported intensity and tempo of therapeutic change, as Belief Coding could act instantly on emotional, cognitive, and somatic aspects of belief systems.

The neurophysiological findings of this experiment have several important implications for therapeutic practice. The distributed nature of neural activation implies that successful belief change needs to engage multiple aspects of neural processing, rather than targeting cognitive or emotional components in isolation. The specific oscillatory changes observed during therapy underscore the need to create appropriate brain states for intervention, that is, the balance between alpha-mediated relaxation and gamma-mediated integration. The engagement of both explicit memory systems (e.g., the hippocampus) and implicit memory systems (e.g., the amygdala and procedural memory) implies that successful therapy must engage both conscious and unconscious processes. The increased connectivity of the default mode network (DMN) underscores the need to target self-referential processing in the context of belief change, that is, how individuals construct and sustain their personal narratives. The specific EEG parameters identified in this experiment have potential to be used as objective indices of therapeutic change, allowing monitoring and optimisation of interventions.

Several limitations must be kept in mind when interpreting the results presented in this study.The use of only female subjects limits the findings' generalizability to the broader population, particularly by gender. Future studies must comprise a representative sample of diverse genders. The control group's relatively small sample size (n=8) might limit statistical power in deciding inter-group differences. Future studies, therefore, must use larger and better-matched control groups. Although substantial neurophysiological changes were reported in relation to Belief Coding therapy, the establishment of a clear causal relationship needs additional experimental controls. The present study examined immediate neurophysiological changes. Longitudinal designs are necessary to identify the stability of such changes over time. Although several neural changes were detected, the precise mechanisms that can be specifically attributed to Belief Coding, in contrast to those that are shared with other types of therapy, require additional study.

Future research directions should include investigations into the longevity of neurophysiological changes over extended periods of time to assess the long-term sustainability of therapeutic effects; comparisons of the neural basis of Belief Coding to that of other established therapeutic techniques; investigations of the ability of baseline EEG measurements to predict responsiveness to therapy and hence enable treatment tailored to individual needs; integrating EEG with other neuroimaging modalities like fMRI to better understand the spatial and temporal aspects of neural changes; and the development of EEG-based protocols for monitoring therapeutic progress and optimizing intervention techniques.

5. Conclusion

This research offers the first empirical examination of the neurophysiological correlates of Belief Coding therapy with high-density EEG. The results demonstrate striking alterations in neural oscillations, network connectivity, and regional activation patterns in relation to this new therapeutic method. These alterations involve several aspects of neural function, such as emotional regulation (alpha coherence), cognitive processing (beta activity), memory integration (gamma synchronisation), emotional processing (delta-theta coupling), and self-referential awareness (DMN connectivity). The distributed pattern of neural engagement, involving more than 32 key brain regions, is consistent with the conceptualisation of Belief Coding as a whole-brain method of therapeutic change. Instead of activating discrete neural systems, this method seems to enable coordinated activity across distributed networks, potentially explaining its reported efficacy in the treatment of deeply ingrained subconscious beliefs. Although additional research is required to fully clarify the specific mechanisms and determine the unique contributions of this method, these initial findings offer compelling neurophysiological evidence for the efficacy of Belief Coding therapy as initially described by Cunningham (2025) and advance our knowledge of the neural basis of belief modification and therapeutic change.

Figures

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